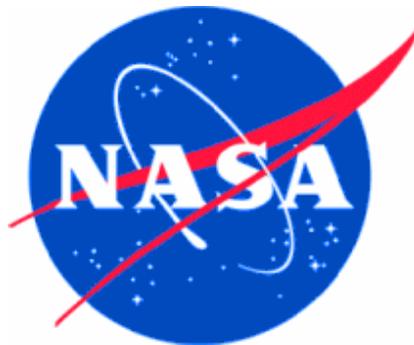

Reuse Enablement System (RES) Requirements

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Background

To address the technical issues required to enable and facilitate reuse of software assets within NASA's Earth Science Enterprise (ESE), the NASA Earth Science Software Reuse Working Group was created as part of the Earth Science Data System (ESDS) Working Group. This was the result of one of the recommendations from the NASA HQ-commissioned Strategic Evolution of ESE Data Systems (SEEDS) Study; the SEEDS activity became the ESDS Working Group activity. The Software Reuse Working Group was chartered to oversee the process that will maximize the reuse potential of such software components in order to: (1) drive down the cost and time of system development and reduce/eliminate unnecessary duplication of effort; (2) increase flexibility and responsiveness relative to Earth science community needs and technological opportunities; and (3) increase effective and accountable community participation.

The Working Group recommends and supports activities that help increase awareness of available software components, increase awareness of the value of reuse, provide needed processes and mechanisms, disseminate successful reuse strategies, and address related intellectual property and policy issues. In the process of fostering greater software reuse across the Earth science systems, the Working Group is considering a wide variety of approaches to help meet differing needs and priorities. One such approach has been the creation of the Software Reuse Working Group portal web site at <http://softwarereuse.nasa.gov/>. It contains information on reusable assets, resources such as events and publications, open source software in general, and funding opportunities as well as some information about the Working Group's projects. Thus, it provides users with a central location for finding information about software reuse.

The goal of the software reuse project is to encourage software developers to make use of existing software assets, including open source software, to provide them with a convenient way to locate and obtain such assets, and to encourage them to develop products for reuse by others. The process of creating a new software product by reusing existing components can be likened to the building of a house. The consumers will be able to buy a completed house, but it is the builders who create the house from a variety of pre-fabricated components such as the frame, windows, and plumbing. By using tools, parts, and methods that have been tested over time and are known to work well, it becomes easier and more efficient for them to build the house. Likewise, if software developers can make use of existing software components, it will be easier and more efficient for them to create new products.

Software released under an open source license is publicly available and other software developers can read, modify, and redistribute the source code. The Working Group has recommended greater use of open source licensing as an important enabler for software reuse. The simpler licensing mechanism of open source, compared to traditional software licensing, eliminates a significant barrier to code sharing and thus helps to encourage and promote reuse. However, open source licensing is not appropriate for all types of software and traditionally licensed software can still be reused. Therefore, an effective reuse program has to accommodate both open source and non-open source software.

To facilitate the software reuse process, developers need to be able to easily locate and evaluate the available reusable artifacts. These were identified as important factors in a

survey (OMB #2700-0117) conducted by the Working Group to determine the reuse practices of the Earth science community. See Appendix A for additional information about the survey.¹ The results showed that when people did not reuse software, the primary reasons were because they did not know where to look and they did not know such reusable software existed. In addition, the survey revealed that a catalog or repository for reusable artifacts is the best means of increasing software reuse within the Earth science community. For this reason, the reusable artifacts should be classified and made available through an appropriate reuse enablement system (e.g., libraries, catalogs, repositories) that can facilitate searching and indexing. These systems are an essential ingredient in transforming ad-hoc reuse (which is largely dependent on personal knowledge and word of mouth dissemination of information about the availability of reusable artifacts) to systematic reuse as an integral part of the software development process.

To achieve the above goal, the Working Group was tasked to research and evaluate existing software catalog and repository systems within NASA, specifically the GCMD and the NASA Open Source Agreement site, as possible alternatives to: (1) hosting software assets for the Earth science community and/or (2) developing an Earth science Reuse Enablement System by using existing enablement system reusable infrastructure software components. See Appendix B for the Working Group's original recommendation and NASA HQ's response. As presented in the Reuse Enablement System (RES) Trade Study document dated November 17, 2005, the results of our study, which also included non-NASA sites, showed that none of the evaluated repository or catalog systems can satisfy the needs of the community of Earth science software developers. Therefore, the Working Group has recommended that NASA provide the necessary support for a reuse enablement system dedicated to the Earth science community that could be expanded to include the space science community. The Working Group will evaluate the technology options for the provision of a reuse enablement system and perform a more detailed architecture study to determine the most expeditious and cost-effective solution for such a system. This document presents the formal requirements for the Reuse Enablement System (RES) that the architecture study will use to evaluate potential systems and software packages.

Applicable and Supporting Documents

- Reuse Enablement System (RES) Trade Study (November 17, 2005)
- Reuse Enablement System (RES) Use Cases (August 10, 2006)

¹ See also the Proceedings of the 2004 IEEE International Geoscience and Remote Sensing Symposium, vol. 3, pp. 2196-2199; "Strategies for Enabling Software Reuse within the Earth Science Community" by Samadi et al. for preliminary results from an earlier, almost identical survey or the Proceedings of the 2006 IEEE International Geoscience and Remote Sensing Symposium, in preparation, "Software Reuse Within the Earth Science Community" by Marshall et al. for initial results from the most recent survey.

Requirements

This section describes the functional requirements for the RES. See Appendix F for a glossary of terms and additional definitions. The rationale matrix for the RES requirements is presented in Appendix C. The requirements traceability matrix for the RES requirements is presented in Appendix D.

1. Users and User Information

1.1. Support of User Types

1.1.1. Support for Consumer User

The system shall provide the ability for users called Consumers to download or otherwise access and use locally stored assets.

1.1.2. Support for Provider User

The system shall provide the ability for users called Providers to submit new assets or asset modifications. Providers also have the same rights and privileges as Consumers.

1.1.3. Support for Administrator User

The system shall facilitate the ability for administrators to approve new users, manage assets, and approve new submissions, modifications, and deletions. Administrators also have the same rights and privileges as Providers.

1.1.4. Support for Content Manager User

The system shall provide the ability for users called Content Managers to review and approve content submitted to the system. Content Managers may also be one of the other user types and will have the same rights and privileges as that user type.

1.2. User Information Storage

1.2.1. Storage of Common User Information

The system shall be capable of storing information for each user, minimally a user name, a password, and a form of contact information (e.g., an e-mail address).

1.2.2. Storage of Provider Information

The system shall be capable of storing information for Providers to indicate their organizational affiliation and area of expertise, as well as the information listed in Requirement 1.2.1.

1.3. User Interface

1.3.1. User Profile Management

The system shall provide a mechanism by which registered users can modify their registered information.

1.3.2. User Request Account Deletion

The system shall provide users with the ability to request account deletion.

2. Asset Storage and Management

2.1. Asset Information Storage

2.1.1. Storage of Asset Information

The system shall require information to be stored for each asset, minimally a title, a description, one or more categories, one or more keywords, and one or more resources (see Requirement 2.1.2).

2.1.2. Storage of Asset Resources

The system shall require that an asset resource be either uploaded and locally stored or externally stored at another Uniform Resource Indicator (URI).

2.1.3. Storage of Asset Versions

The system shall be capable of storing more than one version of an asset.

2.1.4. Scanning of Asset Uploads

The system shall provide the capability to enable virus scanning of uploaded files.

2.2. Asset Discovery

2.2.1. Display Alphabetical Listing of Assets

The system shall provide an alphabetical listing, based on asset title, to Consumers.

2.2.2. Provide Search for Assets

The system shall provide Consumers with the ability to search assets by title, description, and keyword.

2.2.3. Display Hierarchical Navigation of Assets

The system shall provide Consumers with one or more hierarchically categorized listings of assets.

2.3. Asset Management

2.3.1. Provide Registration of New Assets

The system shall provide a method for Providers to submit a new asset, with Content Manager approval.

2.3.2. Provider Modification of Assets

The system shall provide a method for Providers to submit modifications to existing asset metadata and resources.

2.3.3. Provider Approval of Asset Modifications

The Provider of an asset will be the authority for approving modifications to its existing asset metadata and resources.

2.3.4. Provider Request for Asset Removal

The system shall provide a method for Providers to submit an asset removal request.

2.3.5. Provider Categorization of Assets

The system shall provide a method for Providers to submit a modification for an asset category.

2.4. Asset Feedback

2.4.1. Collection of Comments About Assets

The system shall provide the ability to leave textual comments for each asset.

- 2.4.2. Collection of Quantitative Feedback
 - The system shall provide the ability to leave subjective but quantitative ratings for each asset.
- 2.4.3. User Registration of Asset Usage
 - The system shall provide the ability for users to register usage of a particular asset within the system.
- 2.4.4. Feedback by Contacting Providers
 - The system shall provide the capability for users to directly contact a Provider, subject to that Provider's agreement.
- 2.4.5. Display Feedback
 - The system shall display to Consumers previously collected feedback.
- 2.5. Asset Metrics and Reports
 - 2.5.1. Collect Number of Downloads
 - The system shall collect information on how many times a locally stored asset is downloaded.
 - 2.5.2. Collect Number of External Links Accessed
 - The system shall collect information on how many times an externally stored asset is accessed.
 - 2.5.3. Collect Number of Registered Users for Assets
 - The system shall collect information on how many users have registered usage of a particular asset.
 - 2.5.4. Summarize Ratings from Quantitative Feedback
 - The system shall collect and summarize quantitative consumer feedback.
- 2.6. Asset Access Control
 - 2.6.1. Limit Access of Certain Users from Certain Assets
 - The system shall have the capability of limiting the access of certain assets to certain user groups in accordance with system policies.
- 3. Send and Manage Notifications
 - 3.1. Send Notifications for Asset Events
 - 3.1.1. Send Notification on Modification Notification
 - The system shall have the capability of sending notifications when an asset metadata or resource has been modified.
 - 3.1.2. Send Notification on Submission of New Feedback
 - The system shall have the capability of sending notifications when new feedback is left for an asset.
 - 3.2. Send Notifications for System Events
 - 3.2.1. Send Administrative Notification for Asset Information

The system shall have the capability of sending administrative notifications concerning an asset.

3.2.2. Send Administrative Notification for System Information

The system shall have the capability of sending administrative notifications concerning the system.

3.3. Notification Management

3.3.1. User Addition of Notifications for Assets

The system shall provide users with the capability of receiving notifications for each asset.

3.3.2. User Removal of Notifications

The system shall provide users with the capability of removing themselves from notifications.

4. System Operations

4.1. System Feedback

4.1.1. Collection of System Problems

The system shall be capable of collecting bug reports and problems about the operation of the system.

4.1.2. Collection of System Suggestions

The system shall be capable of collecting suggestions about the system.

4.1.3. Feedback by Contacting Administrators

The system shall provide users with the ability to contact Administrators.

4.2. System Policies Compliance, Security, and Privacy

4.2.1. Verification of Provider Information

The system shall provide the capability for Administrators to verify the user information submitted by Providers.

4.2.2. Verification of Provider through Secondary Method or Contact

The system shall provide the capability for Administrators to contact someone other than the user in order to verify the information submitted by the user.

4.2.3. Security of Sensitive Transmitted Information

The system shall be capable of transmitting sensitive information (e.g., user login names and passwords) securely.

4.2.4. Security of Stored Information

The system shall be capable of storing sensitive information securely.

4.2.5. Deletion of Users for Policy Enforcement

The system shall provide the capability of deleting the accounts of users who do not comply with the policies of the system.

4.2.6. Protection of Private Information

The system shall maintain a user's privacy in compliance with relevant policies.

4.2.7. Compliance with Other Technical, Accessibility, and Security Requirements

The system shall comply with all other relevant policies, technical or otherwise (e.g., Section 508 for accessibility).

4.2.8. Policies Availability to Users

The system shall make all policies relevant to users publicly available to users.

4.3. Repository and Catalog

4.3.1. Function as a Repository

The system shall have the capability of functioning as a repository, locally storing the assets to be hosted on the system.

4.3.2. Function as a Catalog

The system shall have the capability of functioning as a catalog, providing links to assets stored remotely.

4.3.3. Selection of System Behavior by Provider

The system shall allow Providers to choose whether the system functions as a repository or a catalog for the assets they submit.

4.3.4. Enforcement of Asset Storage Limit

The system shall have the capability of storing individual assets of up to a maximum total size for all resources for that asset.

4.4. Asset Cleanup

4.4.1. Asset Deprecation by Content Managers

The system shall provide the ability for Content Managers to deprecate assets which are no longer of interest to the community.

4.4.2. Asset Removal by Administrators

The system shall provide the ability for Administrators to remove assets which no longer exist.

4.5. Data Integrity

4.5.1. Verification of Data by Providers

The system shall provide the capability of offering users checksums or an equivalent, when supplied by Providers, for the purposes of data verification.

Verification

This section presents the requirements verification methods for the RES requirements. Four standard verification methods are planned:

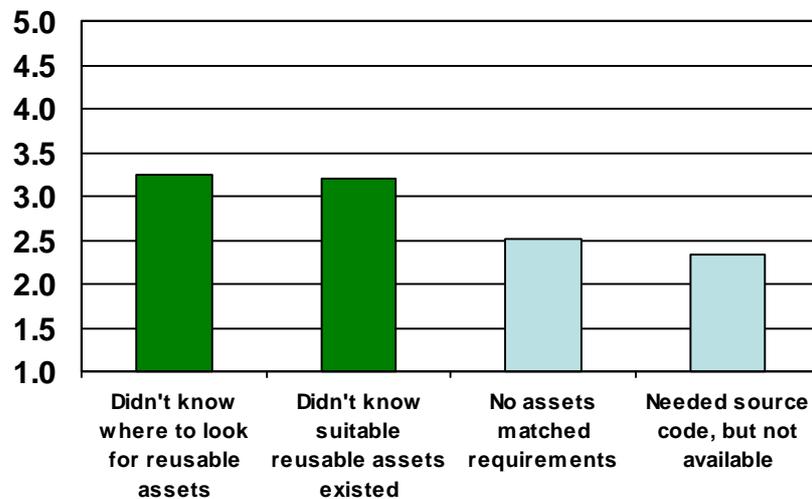
- **Inspection** – a verification method by trained individuals who look for defects using a well defined process. The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with these targets. Inspection can involve verifying interfaces and/or required standards.
- **Analysis** – a verification method that uses proven analytical techniques and/or tools to assess requirements implementation, test results, and other aspects of verification where actual operation conditions cannot be simulated adequately.
- **Demonstration** – verification method using a qualitative method to assess requirements that evaluates properties of the item by observation.
- **Test** – a verification method using a quantitative method to assess functional or performance requirements by measuring output responses to known inputs and expected results. A procedure documents inputs and expected outcomes.

See Appendix E for the accompanying verification matrix.

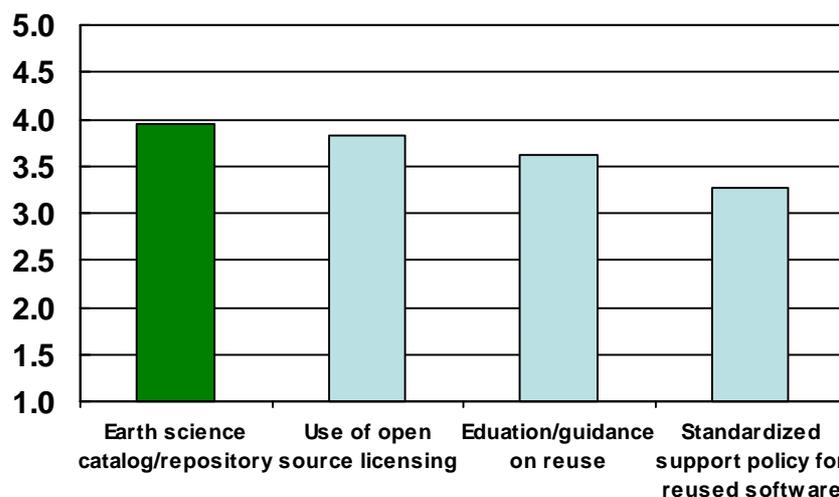
Appendix A – Software Reuse Questionnaire

The majority of the survey consisted of multiple choice questions where each listed option was ranked from 1 (not important at all) to 5 (very important). The following charts show the average results for the top few responses to two of the questions.

Question 7 – How important were the following factors in preventing you from reusing software development artifacts developed outside your group?



Question 47 – In your opinion, how important would the following factors be in helping increase the level of reuse within the Earth science community?



Appendix B – Enabling Systems Recommendation

The Software Reuse Working Group previously submitted a recommendation for a Reuse Enablement System to NASA HQ. This appendix contains the content of that recommendation and HQ's response to it.

- NASA should establish a system to facilitate the cataloging and distribution of reusable assets for the Earth science community
- NASA should establish an effective mechanism for dissemination of reusable assets within the Earth science community
- NASA should evaluate the technology options for the provision of a reuse enablement system including:
 - commercial reuse catalogs/repositories
 - open source reuse catalogs/repositories
 - use of existing publicly available catalogs/repositories
 - custom build of a community-specific catalog
- Based on the conclusions of the technology evaluation, NASA should implement a reuse enablement system
- NASA should develop guidelines and standards for the management and operation of a reuse enablement system

Impact for the Working Group

- The reuse working group will evaluate the technology options for the provision of a reuse enablement system
- The reuse working group will develop guidelines and standards for the management and operation of a reuse enablement system
- The reuse working group will develop a proposal for the implementation of a reuse enablement system based on the conclusions of the technology evaluation
- One additional FTE will be required for the balance of '05 fiscal year

Desired Decision

- HQ agreement to proceed with the evaluation of technology options and to provide funding for the evaluation
- HQ agreement in principle to the establishment of a reuse catalog subject to the findings of the evaluation

Headquarters' Response

- HQ thinks such a recommendation is premature and needs to await the results of a trade study concerning the establishment of a reuse catalog

Appendix C – Rationale Matrix

The rationale matrix for the RES requirements is provided on the following pages.

Requirement Number and Title	Rationale
<i>1 – Users and User Information</i>	<i>N/A</i>
<i>1.1 – Support of User Types</i>	<i>N/A</i>
1.1.1 – Support for Consumer User	Need to provide access to assets.
1.1.2 – Support for Provider User	Need to allow submission of assets.
1.1.3 – Support for Administrator User	Need to manage system.
1.1.4 – Support for Content Manager User	Need to manage content.
<i>1.2 – User Information Storage</i>	<i>N/A</i>
1.2.1 – Storage of Common User Information	Need to allow logins and automatic notifications.
1.2.2 – Storage of Provider Information	Need to confirm Provider's background.
<i>1.3 – User Interface</i>	<i>N/A</i>
1.3.1 – User Profile Management	Need to have current information for users.
1.3.2 – User Request Account Deletion	Need to allow users to permanently leave system.
<i>2 – Asset Storage and Management</i>	<i>N/A</i>
<i>2.1 – Asset Information Storage</i>	<i>N/A</i>
2.1.1 – Storage of Asset Information	Need basic info for storage, discovery, etc.
2.1.2 – Storage of Asset Resources	Need access to provided assets.
2.1.3 – Storage of Asset Versions	Need to allow preservation of old/alternate versions.
2.1.4 – Scanning of Asset Uploads	Need to ensure safety of uploaded assets.
<i>2.2 – Asset Discovery</i>	<i>N/A</i>
2.2.1 – Display Alphabetical Listing of Assets	Need to allow discovery by asset title.
2.2.2 – Provide Search for Assets	Need to allow discovery by search on terms.

Requirement Number and Title	Rationale
2.2.3 – Display Hierarchical Navigation of Assets	Need to allow discovery by asset type/category.
<i>2.3 – Asset Management</i>	<i>N/A</i>
2.3.1 – Provider Registration of New Assets	Need to allow users to provide assets.
2.3.2 – Provider Modification of Assets	Need to allow users to update assets.
2.3.3 – Provider Approval of Asset Modifications	Need to allow Providers to approve updates to own assets.
2.3.4 – Provider Request for Asset Removal	Need to allow removal of assets from system.
2.3.5 – Provider Categorization of Assets	Need to allow change of asset category.
<i>2.4 – Asset Feedback</i>	<i>N/A</i>
2.4.1 – Collection of Comments About Assets	Need to allow text reviews of assets.
2.4.2 – Collection of Quantitative Feedback	Need to allow ratings of assets.
2.4.3 – User Registration of Asset Usage	Need to allow users to indicate active usage of asset.
2.4.4 – Feedback by Contacting Providers	Need to allow users to contact asset providers.
2.4.5 – Display Feedback	Need to display previously collected feedback.
<i>2.5 – Asset Metrics and Reports</i>	<i>N/A</i>
2.5.1 – Collect Number of Downloads	Need to track number of asset downloads.
2.5.2 – Collect Number of External Links Accessed	Need to track number of times links are followed.
2.5.3 – Collect Number of Registered Users for Assets	Need to track number of users registering assets.
2.5.4 – Summarize Ratings from Quantitative Feedback	Need to collect and summarize user ratings.
<i>2.6 – Access Control</i>	<i>N/A</i>
2.6.1 – Limit Access of Certain Users from Certain Assets	Need to restrict access to assets when required.
<i>3 – Send and Manage Notifications</i>	<i>N/A</i>

Requirement Number and Title	Rationale
<i>3.1 – Send Notifications for Asset Events</i>	<i>N/A</i>
3.1.1 – Send Notification on Modification of Asset	Need to allow notification of asset modifications.
3.1.1 – Send Notification on Submission of New Feedback	Need to allow notification of asset feedback.
<i>3.2 – Send Notification for System Events</i>	<i>N/A</i>
3.2.1 – Send Administrative Notification for Asset Information	Need to allow notification of asset-related news.
3.2.2 – Send Administrative Notification for System Information	Need to allow notification of system-related news.
<i>3.2 – Notification Management</i>	<i>N/A</i>
3.2.1 – User Addition of Notifications	Need to allow users to add notifications.
3.2.2 – User Removal of Notifications	Need to allow users to remove notifications.
<i>4 – System Operations</i>	<i>N/A</i>
<i>4.1 – System Feedback</i>	<i>N/A</i>
4.1.1 – Collection of System Problems	Need to allow users to report system problems.
4.1.2 – Collection of System Suggestions	Need to allow users to suggest system improvements.
4.1.3 – Feedback by Administrator Contact	Need to allow users to contact administrators.
<i>4.2 – System Policies Compliance, Security, and Privacy</i>	<i>N/A</i>
4.2.1 – Verification of Provider Information	Need to verify Providers' background/expertise.
4.2.2 – Verification of Provider through Secondary Method or Contact	Need to confirm Providers' identity.
4.2.3 – Security of Sensitive Transmitted Information	Need to provide security of data during transmission.
4.2.4 – Security of Stored Information	Need to provide security of data being stored.
4.2.5 – Deletion of Users for Policy Enforcement	Need to enforce compliance with policies.

Requirement Number and Title	Rationale
4.2.6 – Protection of Private Information	Need to maintain users' privacy.
4.2.7 – Compliance with Other Technical, Accessibility, and Security Requirements	Need to comply with other relevant policies.
4.2.8 – Policies Availability to Users	Need to allow users access to all relevant policies.
<i>4.3 – Repository and Catalog</i>	<i>N/A</i>
4.3.1 – Function as a Repository	Need to be able to store assets locally.
4.3.2 – Function as a Catalog	Need to be able to link to assets stored remotely.
4.3.3 – Selection of System Behavior by Provider	Need to allow providers to choose storage method.
4.3.4 – Enforcement of Asset Storage Limit	Need to limit asset size for system integrity.
<i>4.4 – Asset Cleanup</i>	<i>N/A</i>
4.4.1 – Asset Deprecation	Need to ensure system has relevant content.
4.4.2 – Asset Removal	Need to ensure system has relevant content.
<i>4.5 – Data Integrity</i>	<i>N/A</i>
4.5.1 – Data Verification	Need to allow method for checking data integrity.

Appendix D – Requirements Traceability Matrix

The table provided on the following pages provides traceability of the requirements contained in this specification to the use cases contained in the Reuse Enablement System (RES) Use Case document.

Requirement Number and Title	Rationale
<i>1 – Users and User Information</i>	<i>N/A</i>
<i>1.1 – Support of User Types</i>	<i>N/A</i>
1.1.1 – Support for Consumer User	Derived from Use Case 001 and others
1.1.2 – Support for Provider User	Derived from Use Case 001 and others
1.1.3 – Support for Administrator User	Derived from Use Case 001 and others
1.1.4 – Support for Content Manager User	Derived from Use Case 019
<i>1.2 – User Information Storage</i>	<i>N/A</i>
1.2.1 – Storage of Common User Information	Use Case 001
1.2.2 – Storage of Provider Information	Use Case 001
<i>1.3 – User Interface</i>	<i>N/A</i>
1.3.1 – User Profile Management	Use Case 013
1.3.2 – User Request Account Deletion	Derived from Use Case 013
<i>2 – Asset Storage and Management</i>	<i>N/A</i>
<i>2.1 – Asset Information Storage</i>	<i>N/A</i>
2.1.1 – Storage of Asset Information	Use Case 002
2.1.2 – Storage of Asset Resources	Use Case 002
2.1.3 – Storage of Asset Versions	Derived from Use Case 003
2.1.4 – Scanning of Asset Uploads	Derived from Working Group
<i>2.2 – Asset Discovery</i>	<i>N/A</i>
2.2.1 – Display Alphabetical Listing of Assets	Derived from Use Case 006

Requirement Number and Title	Rationale
2.2.2 – Provide Search for Assets	Use Case 006
2.2.3 – Display Hierarchical Navigation of Assets	Use Case 006
<i>2.3 – Asset Management</i>	<i>N/A</i>
2.3.1 – Provider Registration of New Assets	Use Cases 002 and 019
2.3.2 – Provider Modification of Assets	Use Case 003
2.3.3 – Provider Approval of Asset Modifications	Derived from Working Group
2.3.4 – Provider Request for Asset Removal	Use Case 003
2.3.5 – Provider Categorization of Assets	Derived from Use Case 003
<i>2.4 – Asset Feedback</i>	<i>N/A</i>
2.4.1 – Collection of Comments About Assets	Use Case 010
2.4.2 – Collection of Quantitative Feedback	Use Case 010
2.4.3 – User Registration of Asset Usage	Use Case 009
2.4.4 – Feedback by Contacting Providers	Derived from Use Case 010
2.4.5 – Display Feedback	Use Case 010
<i>2.5 – Asset Metrics and Reports</i>	<i>N/A</i>
2.5.1 – Collect Number of Downloads	Derived from Use Case 009
2.5.2 – Collect Number of External Links Accessed	Derived from Use Case 009
2.5.3 – Collect Number of Registered Users for Assets	Derived from Use Case 009
2.5.4 – Summarize Ratings from Quantitative Feedback	Use Case 010
<i>2.6 – Access Control</i>	<i>N/A</i>
2.6.1 – Limit Access of Certain Users from Certain Assets	Use Case 012

Requirement Number and Title	Rationale
<i>3 – Send and Manage Notifications</i>	<i>N/A</i>
<i>3.1 – Send Notifications for Asset Events</i>	<i>N/A</i>
<i>3.1.1 – Send Notification on Modification of Asset</i>	Derived from Use Case 005
<i>3.1.1 – Send Notification on Submission of New Feedback</i>	Derived from Use Case 005
<i>3.2 – Send Notification for System Events</i>	<i>N/A</i>
<i>3.2.1 – Send Administrative Notification for Asset Information</i>	Derived from Use Case 005
<i>3.2.2 – Send Administrative Notification for System Information</i>	Derived from Use Case 005
<i>3.2 – Notification Management</i>	<i>N/A</i>
<i>3.2.1 – User Addition of Notifications</i>	Use Case 005
<i>3.2.2 – User Removal of Notifications</i>	Use Case 005
<i>4 – System Operations</i>	<i>N/A</i>
<i>4.1 – System Feedback</i>	<i>N/A</i>
<i>4.1.1 – Collection of System Problems</i>	Use Case 004
<i>4.1.2 – Collection of System Suggestions</i>	Use Case 004
<i>4.1.3 – Feedback by Administrator Contact</i>	Derived from Use Case 004
<i>4.2 – System Policies Compliance, Security, and Privacy</i>	<i>N/A</i>
<i>4.2.1 – Verification of Provider Information</i>	Derived from Working Group
<i>4.2.2 – Verification of Provider through Secondary Method or Contact</i>	Derived from Working Group
<i>4.2.3 – Security of Sensitive Transmitted Information</i>	Derived from Working Group
<i>4.2.4 – Security of Stored Information</i>	Derived from Working Group
<i>4.2.5 – Deletion of Users for Policy</i>	Derived from Working Group

Requirement Number and Title	Rationale
Enforcement	
4.2.6 – Protection of Private Information	Derived from Working Group
4.2.7 – Compliance with Other Technical, Accessibility, and Security Requirements	Derived from Working Group
4.2.8 – Policies Availability to Users	Derived from Working Group
<i>4.3 – Repository and Catalog</i>	<i>N/A</i>
4.3.1 – Function as a Repository	Use Case 002 and others
4.3.2 – Function as a Catalog	Use Case 002 and others
4.3.3 – Selection of System Behavior by Provider	Use Case 002 and others
4.3.4 – Enforcement of Asset Storage Limit	Derived from Working Group
<i>4.4 – Asset Cleanup</i>	<i>N/A</i>
4.4.1 – Asset Deprecation	Derived from Use Case 020
4.4.2 – Asset Removal	Use Case 020
<i>4.5 – Data Integrity</i>	<i>N/A</i>
4.5.1 – Data Verification	Derived from Working Group

Appendix E – Verification Cross-Reference Matrix

Requirement Number and Title	Verification Method			
	Inspection	Analysis	Demo	Test
<i>1 – Users and User Information</i>	N/A			
<i>1.1 – Support of User Types</i>	N/A			
1.1.1 – Support for Consumer User	X			
1.1.2 – Support for Provider User	X			
1.1.3 – Support for Administrator User	X			
1.1.4 – Support for Content Manager User	X			
<i>1.2 – User Information Storage</i>	N/A			
1.2.1 – Storage of Common User Information				X
1.2.2 – Storage of Provider Information				X
<i>1.3 – User Interface</i>	N/A			
1.3.1 – User Profile Management	X			
1.3.2 – User Request Account Deletion				X
<i>2 – Asset Storage and Management</i>	N/A			
<i>2.1 – Asset Information Storage</i>	N/A			
2.1.1 – Storage of Asset Information				X
2.1.2 – Storage of Asset Resources				X
2.1.3 – Storage of Asset Versions				X
2.1.4 – Scanning of Asset Uploads		X		
<i>2.2 – Asset Discovery</i>	N/A			
2.2.1 – Display Alphabetical Listing of Assets	X			

Requirement Number and Title	Verification Method			
	Inspection	Analysis	Demo	Test
2.2.2 – Provide Search for Assets				X
2.2.3 – Display Hierarchical Navigation of Assets	X			
2.3 – <i>Asset Management</i>	N/A			
2.3.1 – Provider Registration of New Assets				X
2.3.2 – Provider Modification of Asset				X
2.3.3 – Provider Approval of Asset Modifications				X
2.3.4 – Provider Request for Asset Removal				X
2.3.5 – Provider Categorization Asset				X
2.4 – <i>Asset Feedback</i>	N/A			
2.4.1 – Collection of Comments About Assets				X
2.4.2 – Collection of Quantitative Feedback				X
2.4.3 – User Registration of Asset Usage				X
2.4.4 – Feedback by Contacting Providers				X
2.4.5 – Display Feedback				X
2.5 – <i>Asset Metrics and Reports</i>	N/A			
2.5.1 – Collect Number of Downloads			X	
2.5.2 – Collect Number of External Links Accessed			X	
2.5.3 – Collect Number of Registered Users for Assets			X	
2.5.4 – Summarize Ratings from Quantitative Feedback				X
2.6 – <i>Asset Access Control</i>	N/A			
2.6.1 – Limit Access of Certain Users from				X

Requirement Number and Title	Verification Method			
	Inspection	Analysis	Demo	Test
Certain Assets				
<i>3 – Send and Manage Notifications</i>	<i>N/A</i>			
<i>3.1 – Send Notifications for Asset Events</i>	<i>N/A</i>			
3.1.1 – Send Notification on Modification of Asset				X
3.1.2 – Send Notification on Submission of New Feedback				X
<i>3.1.2 – Send Notification for System Events</i>	<i>N/A</i>			
3.2.1 – Send Administrative Notification for Asset Information				X
3.2.2 – Send Administrative Notification for System Information				X
<i>3.3 – Notification Management</i>	<i>N/A</i>			
3.3.1 – User Addition of Notifications for Assets				X
3.3.2 – User Removal of Notifications				X
<i>4 – System Operations</i>	<i>N/A</i>			
<i>4.1 – System Feedback</i>	<i>N/A</i>			
4.1.1 – Collection of System Problems	X			
4.1.2 – Collection of System Suggestions	X			
4.1.3 – Feedback by Contacting Administrators	X			
<i>4.2 – System Policies Compliance, Security, and Privacy</i>	<i>N/A</i>			
4.2.1 – Verification of Provider Information	X			
4.2.2 – Verification of Provider through Secondary Method or Contact	X			

Requirement Number and Title	Verification Method			
	Inspection	Analysis	Demo	Test
4.2.3 – Security of Sensitive Transmitted Information				X
4.2.4 – Security of Stored Information				X
4.2.5 – Deletion of Users for Policy Enforcement	X			
4.2.6 – Protection of Private Information		X		
4.2.7 – Compliance with Other Technical, Accessibility, and Security Requirements		X		
4.2.8 – Policies Availability to Users			X	
<i>4.3 – Repository and Catalog</i>	N/A			
4.3.1 – Function as a Repository			X	
4.3.2 – Function as a Catalog			X	
4.3.3 – Selection of System Behavior by Provider			X	
4.3.4 – Enforcement of Asset Storage Limit				X
<i>4.4 – Asset Cleanup</i>	N/A			
4.4.1 – Asset Deprecation by Content Managers				X
4.4.2 – Asset Removal by Administrators				X
<i>4.5 – Data Integrity</i>	N/A			
4.5.1 – Verification of Data by Providers	X			

Appendix F – Glossary of Terms

- Administrator – a user who controls, operates, and manages the system
- Asset – an item produced at some point in the software development life cycle that is recognized as having a particular value
- Catalog – a system that stores links to assets, but does not store/host the assets themselves
- Consumer – a user, either registered or unregistered, who is allowed to access or otherwise use assets in the system, subject to their license terms
- Content Manager – a user whose main role is to review content submitted to the system (e.g., a new asset) for appropriateness and relevance
- Provider – a registered user who has been granted permission to upload asset resources and metadata to the system
- Registered user – a user who has completed a registration process in order to obtain an account on the system
- Repository – a system that stores/hosts the actual assets themselves
- Submit – refers to the process by which information is provided to the system for inclusion in the system
- Unregistered user – a user who has not completed a registration process in order to obtain an account on the system
- User – any person who accesses the system